SHOULD THE ALASKA PIPELINE BE APPROVED?

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New Scientist and Science Journal

8 April 1971

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Bryan Sage

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changes are probably governed more by available jobs (hence federal and corporate expenditures and policy) than by academic preferences of employees. The current tightening of the job market for physicists is one example; funds for curiosity-oriented basic research are being severely cut in government and business, especially by the Department of Defense, under pressure of mission-oriented goals. The projections in first and second degree students anticipate very substantial increases in social science baccalaureates, but not in doctorates five years later (partly by choice and partly because the median elapsed time between these two degrees is 6.3 years in the physical sciences, 7.3 years in the biological sciences, but 8.0 years in the social sciences). It is possible that the value-group origins of this expansion might be found among the *humanist left* and the *educational and scientific estate.* The bulk of doctorates five years later are in the physical sciences, but the share in life sciences might well expand beyond these forecasts. The *educational and scientific estate* and the *responsible centre* should continue to contribute to these categories, more or less at a rate commensurate with their size and present performance. The number of baccalaureates among engineers levels off rapidly in the late 1960s and mid 1970s, unlike the other curves. The reason is unlikely to be because of a drop in the size or contributions of *middle America* or the *responsible centre;* it is probably due to reduced expenditures and policies which discourage students from taking engineering.

Both the universities and government agencies will grow more concerned with social and environmental issues. Members of the *humanist left* will tend to react more strongly against the physical sciences, development and goods-orientation; more favourably towards the social and life sciences, working for the government (to some extent corporations), and in curiosity, and mission-oriented research. The *educational and scientific estate* will lose interest in the exact sciences, become somewhat more interested in administration and mission-oriented research helpful to society, and slightly more accepting of improvements that science and technology provide. *Responsible centrists* will find physical and life sciences and basic research more attractive, and social sciences less so, although to them technology will retain and increase its appeal. *Middle Americans* will find the social sciences less important and the physical life sciences more important; knowledge and development activities may tend to occupy and interest them more. The *poor* will react against the fruits of technology denied them, some aiming for the engineering jobs (possibly in government and corporations), and continuing to stay away from the "hard" sciences.

The influence that these constituencies exert on the actual course of events naturally hinges upon their numerical strength, the effectiveness of their spokesmen, their leadership and representation in government, and on the issues and overall climate of the times.

The future is determined largely by present policies, and present policies are themselves determined partially by value assessments of likely new developments in science and technology. Thus, planners of the future can aim policy and funding at fulfilling social needs. An issue such as rehabilitation of the environment, for instance, attracts general approval. By drawing up charts showing the cross-impacts of values and technological developments suggest the methodologies and research programmes that can help to focus our prognostications upon the dim, provocative horizon we call the future.

Should the Alaska pipeline be approved?

When public hearings opened in Washington recently on plans for a trans-Alaska oil pipeline, the il industry expected federal approval to follow rapidly. Instead, objections have multiplied, id the pipeline project now looks farther away than ever. An American conservationist puts the ase for the opposition

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Bryan Sage, of British Petroleum, writing recently in New Scienist (vol 49, p 294), said that on the basis of the latest research the oil industry believes ecological hazards associated with the Alaska pipeline-tanker system "should prove acceptable". Arriving at an acceptable level of ecological hazards of course depends on what your measure is. Acceptable to whom? To the natives of the North Slope and Brooks Range, whose ancient hunting and fishing livelihood will be endangered? To the residents of the coasts of British Columbia, Washington, Oregon and California, who can expect the unspoiled portions of the coastline oil fouled from the normal (and sometimes abnormal) operations of a tanker route? To the men and women of Alaska, who settled the land for reasons other than a boom-and-bust economy? Or to the non-voting, non-human residents of the Arctic, who may not be as assured as the industry is by this latest round of instant research?

Or perhaps arriving at an acceptable level of hazard depends on where you build your ecological fences. I remember that old story about British spinsters: house cats, mice, bumblebees, red clover, beef cattle—and the wellbeing of the Empire. That story made good ecological sense to me when I first heard it, and it still makes sense. But an evaluation of the Alaska pipeline system which leaves out earthquakes, the network of feeder and collector lines on the North Slope, threats to Prince William and Puget Sound from the tanker route, and the ultimate environmental effects of using the oil we are budgeting for, seems to make no ecological sense at all. The industry and the government need

either to widen their ecological horizons, or to admit that ecology has become a new form of advertising.

It was clear at the recent US Department of Interior hearings that there were still too many unanswered questions to allow construction at this time. The department itself admits to inadequate knowledge of the effects of the pipeline. Its Draft Environmental Impact Statement says: "Information upon which to develop a comprehensive discussion of the probable impacts is incomplete, inasmuch as basic data on specific habitats in the semi-wilderness and wilderness areas of the route are incomplete and life histories of many species are not well understood."

This admission from the department contrasts with the assurance of the industry. The arctic ecosystem, a complex system involving many variables, has been studied for years by US researchers who would be loath to make any resounding generalisations about how that system functions. We barely understand the first thing about vole population cycles, let alone the long-range effects of a 789-mile hot-oil pipeline on the US's last great wilderness. We therefore view with less than glee the hurry-up studies of the industry which confidently predict no interference to wildlife from an elevated hot-oil line. Caribou may use gravel roads on the flat North Slope, but one cannot then extrapolate that they will use elevated ramps over a four-foot-diameter pipeline.

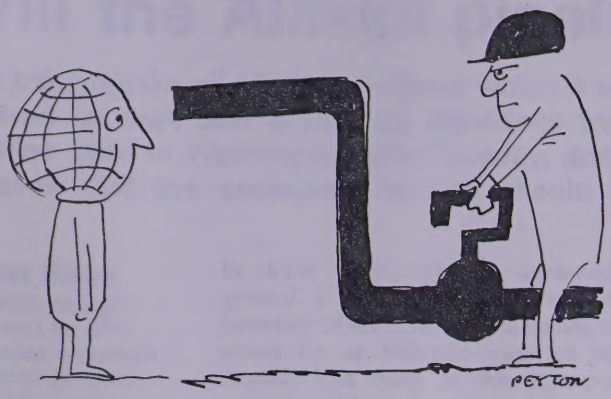
Stipulations on construction

The industry and the Department of Interior both depend on Interior's stipulations on the construction and operation of the pipeline to "reduce foreseeable environmental costs to acceptable levels". What safeguards do these stipulations offer? As I pointed out in testimony before the Senate Committee on Interior and Insular Affairs in September 1969, the stipulations contain a loophole which cancels whatever protection they might offer. The loophole, entitled Changes in Conditions Section B 3, states: "Unforeseen conditions arising during construction and operation of the pipeline may make it necessary to revise or amend these stipulations. In that event, permittee and the authorised officer shall agree as to what provisions or amendments shall be made." Right now there is a great rush to push the project through because of the commitment of time and money already made by the pipeline companies. (This will be the biggest single construction project ever undertaken by a private industry.) If the permit is approved and work proceeds the investment will mount rapidly and it will become less and less likely that work in the field will stop if stipulations cannot be met. It is more likely that the stipulations will be altered to meet field conditions. In effect, the stipulations guarantee nothing. Yet these are paraded by Interior as the "stiff regulations that would . . . reduce . . . environmental costs . . . to an acceptable level".

We question the assumption that development of Prudhoe Bay at this time would, by relieving "western dependence on Middle East oil", provide for "the strength, growth, and security of the United States". I cannot accept the argument that we must develop arctic oil for US national defence, when I read that only 3 per cent of our domestic consumption comes from middle eastern sources. Nor can I believe that our best defence or security comes from using up a resource rather than conserving it; or that we must choose the environmental destruction of the state of Alaska and the cultural destruction of its native population in order to send oil at reduced rates to Japan, there to produce more smog in a nation that is already panting for lack of oxygen. By the Interior Department's own admission the oil supply crisis (if there is a crisis) is at least 10 to 15 years away, and the least we can do is take that time to conduct proper studies and really investigate our oil development, transportation, and use policy. Even if it takes five years to build the trans-Alaska pipeline we still have at least five years to explore route and utilisation alternatives, to obtain better pipeline designs, to develop a safety system that works and to complete our research.

Let us not for a moment forget that a hot-oil pipeline has never been built and operated under these conditions. We have been told that you cannot even shut down the pipe in the southerly part of its route because the oil would freeze in it and you could never get it started again. The test pipe buried near Fairbanks may yield some information about conditions in the taiga—and may make nice copy for press handouts—but it doesn't tell us anything about a hot-oil line buried in tundra permafrost. We need proper studies based on the construction and testing of a prototype line, together with its attendant safety system and methods of resuming operation following breaks, both at the north and south ends, and at points along the middle. We also need to know more about the ecological effects of a complex collection and feeder system on the shores of Prudhoe Bay. This system, involving hundreds of miles of line, is not covered by the stipulations. To our knowledge, no field studies of the specific problems of well-head control, storage, or intermittent line utilisation under the appropriate conditions have yet been conducted.

What do the reported results of the IBP study of Prudhoe Bay crude on tundra field plots mean? Bryan Sage wrote: "The experiments indicated an effect on quantity and quality of the microbial biomass; a 200-300 per cent increase in the numbers of bacteria was noted. On the other hand, some organisms such as fungi and algae were apparently inhibited." Stating it this way is not quite cricket. Although the facts may be accurate, the implications are not. Having been led as nations to believe that more is better, should we rejoice over this increase in bacteria and feel that the oil is actually doing a good job lying around there in the organic layer? After all, we're getting more of something, and that seems quite productive. But by that line of reasoning we should all wish for typhoid fever. Remembering J. B. S. Haldane's sick cheese (in Possible Worlds), we are going to have a very sick tundra in the more-than-likely event of an oil spill. Bacteria will reproduce to eat the oil, but what



will they eat when the oil is gone, and what will happen to the rest of the community in the meantime? The inhibition of fungi and algae means the inhibition of lichen, the principal food of the caribou. Having a lot of bacteria around eating a lot of oil doesn't represent a very stable or diverse system, and isn't going to help the caribou much.

Nor are we terribly impressed by the much-heralded results of reseeding experiments conducted by Atlantic Richfield and others. Full-page full-colour ads sprouted in US magazines long before the seeds assured us they liked Prudhoe Bay. My suspicion about this grass is that it either would have got there before and made it on its own, or it's going to take constant management, with attendant new variables, to make it succeed in the long run. The chances of these imported grasses fitting in and becoming nice quiet members of a stable community, neither eaten up nor ignored and overcompeting, seems unlikely. Already we have seen news items which half-boast, half-complain, that the new grasses are so wonderful that the caribou prefer them. What will the industry do then? Build a caribou-proof fence along its right of way to protect the exotic grasses sown to prevent erosion? We have a right to expect and demand more sophisticated ecological thinking than that.

And I find the rationale behind not worrying too much about the effects of the pipeline on wildlife to be exceedingly strange. Bryan Sage expects us to be reassured by the low density and rarity of wildlife species along the route—a kind of since-there-are-so-few-it-won't-hurt-them-much mentality. I am more rather than less concerned about effects of construction on breeding birds of prey when I am told that the number of pairs was low. We know the peregrine falcon is rare and endangered. That is part of our concern. Nor are we reassured by the information that nest sites are half a mile away from the right of way. Men and machines and birds travel—and it is folly to assume that they will not intersect or affect one another. We also know that densities are low in the arctic, but remember that distances are enormous, and that low densities still result in very high numbers.

All the studies are strangely silent when it comes to earthquake hazards. The Department of Interior takes care of them with some word-magic. The industry doesn't even discuss them. Alaska is one of the most seismically active regions on the globe. Seventy per cent of the pipeline route is within violent-shaking distance of major epicentres plotted by the US Bureau of Land Management. The alternate tanker-free pipeline route through Canada is similarly threatened by earthquakes for only three per cent of its length.

Valdez, the pipeline's southern terminal, was levelled in the 1964 earthquake, and had to be completely rebuilt. Now the industry plans a massive tank-farm complex in the region of the worst of the 1964 quake. It plans to put its monitoring and remote control system for the entire pipeline route there. And the Department of Interior, to reassure us, stipulates that facilities will be designed to withstand 8.5 Richter *when feasible*! Moreover, if it's not feasible then we can look forward to the possibility of from 2 to 20 million barrels of oil running into Prince William Sound should the tanks rupture during a very likely earthquake. When we get into problems of this magnitude, the full-colour ads of grass growing on the tundra become quite pallid.

Canadians are concerned about the oil-polluting effects of tanker operations out of Valdez. David Anderson MP from Victoria, British Columbia, appeared at the Washington hearings and asked to see a map of the tanker route. There wasn't one available. There is no mention of the tanker route in the Draft Environmental Impact Statement. This would be one of the most heavily travelled routes in the world, and its attendant problems are not going to disappear if we just don't mention them.

Power pollutes

There are real alternatives to developing the Prudhoe Bay reserves at this time. We need an intelligent and conservative energy-use policy for the entire globe. All power pollutes, and until we can clean up and refine our utilisation systems, it makes good sense to cut back on use rather than promote it. It has been said often (but not yet clearly enough to the right people) that this is a finite planet with finite resources. We cannot let our emotional addiction to progress and careless technology blind our greater intelligence. Paradoxically, man can use the system of analysis called ecology, either to deceive himself or to help solve his deepest problems. We should be planning for the next 1000 years, rather than for the next 10. If we insist on leaving to our heirs our radioactive garbage to mind for the next 1000 years, we should at least leave them something to keep warm with while they wait, and some beauty and diversity to keep them sane. Using up our oil, our air, our oceans and our wilderness, in order to travel ever faster, to obsolesce things ever sooner, and to overheat and overcool more and more places for an ever-growing population to collect gadgets in—this is not a practice to become over-enamoured of.

We shall need to learn to live within the Earth's income soon. Why not now, while there is still a world around us with beauty and truth that can endure? Survival is not enough, and our present reckless course is foreclosing even on that. The proposed trans-Alaska pipeline is the epitome of that recklessness. Surely the oil industry and its customers can do better.

Will the Alaska pipeline be built?

ne trans-Alaska oil pipeline, without which it will be hard to exploit this large new field, has been elayed for well over a year by objections from conservationists. Hearings on a permit for the peline open in Washington next Tuesday, and on the basis of the latest research the oil industry elieves that the ecological hazards should prove acceptable

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In April 1970 American conservationists were granted a court injunction restraining the US Secretary of the Interior from issuing a construction permit for an 800-mile crude oil pipeline across Alaska. The basis of this injunction was that nothing had been done to comply with the requirements of the National Environmental Policy Act of 1969. Since then, the group responsible for design and construction of the Trans Alaska Pipeline System (TAPS) has been reorganised into the Alyeska Pipeline Service Company. More to the point, a great deal of research has been carried out on the environmental aspects of the pipeline proposal.

A milestone in this controversy was reached in January 1971 when the US Department of the Interior issued their draft Environmental Impact Statement in respect of the pipeline. Basically, this detailed document reaches the conclusion that construction of the pipeline across Alaska would create some unavoidable environmental damage, but that arctic-oil is "essential to the strength, growth and security of the United States", and that stiff regulations on the construction and operation of the pipeline would "reduce foreseeable environmental costs to acceptable levels".

Whether or not the conclusions reached by the Department of the Interior on this thorny question will be acceptable to the conservation opponents of the scheme is another matter, but this will become clear enough at the public hearings scheduled to take place next week in Washington DC, and in Anchorage, Alaska, the week after. It would be naive to suppose that there will be no further argument. Thinking on the subject of arctic oil is bound to be influenced by the recent proceedings at the OPEC (Organisation of Petroleum Exporting Countries) meeting in Tehran, which have underlined western dependence on Middle East Oil.

Objections to the pipeline project have covered such a wide field from the purely aesthetic to the strictly scientific, that it is impossible to mention them all here. They have ranged from intrusion into the last remaining North American wilderness, through erosion, habitat destruction, disruption of established patterns of wildlife movements to terrestrial and marine oil pollution and so on. It is now certain, on the basis of the United States Geological Survey's assessment on soil conditions along the route, that some 48 per cent of the pipeline may be elevated above the ground. This is a far cry from the original industry intention of burying all but about 10 per cent and will certainly upset some game biologists who will see in these elevated stretches an obstacle to the free movement of large mammals.

One of the first objections raised to the development of oil in arctic Alaska was that ecologists did not know enough about the tundra ecosystem to predict the long term consequences. A start in rectifying this situation was made with the establishment of the IBP tundra biome project, to which British Petroleum and Atlantic Richfield made substantial financial and logistic contributions in 1970. The first report of this project has now been published (J. Brown & G. C. West, US IBP Tundra Biome Report 70–71) and a good start has been made in ascertaining what makes the tundra ecosystem tick.

Whilst the normal structure and function of the tundra ecosystem is one of the main avenues of investigation, other aspects have not been neglected. Special attention was paid to the possible effects of terrestrial pollution in the unlikely event of a leakage from the pipeline. There are no previous data on the fate of hydrocarbons in the tundra environment; more than passing interest, therefore, attaches to the preliminary IBP experiments.

More research needed

Further research on a long term basis is necessary before definite conclusions can be reached on this subject, but the initial indications are nevertheless important. Experiments with Prudhoe Bay crude on tundra field plots showed that on drier soils oil penetrated in some cases to the permafrost, while on wet soils it did not get much below the organic layer. Organic matter, in wetter conditions, was able to absorb large quantities of oil. The depth of thaw at the time of these tests was 3–6 centimetres. On a relatively dry site with a shallow organic layer and a sandy-gravel subsoil, the experiments indicated an effect on quality and quantity of the microbial biomass: a 200–300 per cent increase in the numbers of bacteria was noted. On the other hand some organisms such as fungi and algae were apparently inhibited.

The question of erosion is closely tied to revegetation of the construction corridor. Both field and laboratory studies on this aspect were started in 1968 but only really got going in 1970, with field plots located all along the pipeline route from Valdez north to the arctic coast. Revegetation is relevant whether or not the pipe is buried, as the right-of-way corridor must be completely cleared for construction. The results available from the studies on tundra and taiga revegetation, in areas where the pipeline is to be elevated, suggest that there will be no serious revegetation problems in this respect, and many species are showing great promise. The success of the seeding methods used along the gravel road from Fairbanks to the Yukon River was most gratifying, and a good crop of

grasses shaded the soil and prevented permafrost degradation. A right-of-way corridor averaging 100 ft in width throughout the route will take up only about 15 square miles of land.

Of even greater interest is the hot pipeline experiment being conducted at the University of Alaska on behalf of Alyeska. A 600 ft section of pipeline has been buried in an area which crosses three edaphic-vegetation zones in a basically taiga area. The various species being tested fall into four groups: 1. cold-tolerant grasses available from commercial sources; 2. warmer climate drought-resistant species, which may be more appropriate above and near the buried pipeline; 3. native shrubs and trees, and 4. native herbaceous plants.

This heated pipeline experiment is basically studying the potential thaw bulb and the implications of thermal change on the survival and success of plants. The surface temperature along the pipeline is likely to remain fairly static at or above 100°F while winter air temperatures may drop as low as −70°F. The requirement is, therefore, for species that can tolerate such extreme variation. Among the effects that heated soil may be expected to produce is an increase in metabolic activity of overwintering root systems. This could result in a decrease of stored food reserves such as carbohydrates and lipids, which are essential for winter survival and subsequent spring growth. Early growth of plants on the experimental area has shown some correlation with heat from the buried pipe. Grasses such as Bromus and Agropyron germinated up to two weeks earlier on the heated area compared with plants 15 or more feet from the pipe. The critical test is the survival rate during the winter of 1970–71, which will not, of course, be known for some time.

My own research has been concentrated mainly on wildlife aspects. One objection to development on the North Slope has been that waterfowl populations may be seriously affected. It is now clear that in the area between the Sagavanirktok and Kuparak River valleys, which includes the northern part of the pipeline route and the Prudhoe Bay oilfields, waterfowl are at a low density, averaging only 2.8 pairs per square mile rising to 5.8 in a few exceptionally favourable sections. Furthermore, a large proportion of these ducks and geese are non-breeders. An ornithological survey of the Sagavanirktok and Atigun valleys in 1969 and 1970 recorded the occurrence of 72 species (excluding the delta area of the former river), but with one or two exceptions such as the Lapland longspur, population densities of all species were markedly low.

In view of the concern expressed over the effects of pipeline construction on breeding birds of prey, a survey of the entire pipeline route was made in 1970 and all nesting sites mapped. The number of pairs of the various species was surprisingly low, and no nest sites were nearer than half a mile from the pipeline right of way.

Work on mammals was concentrated on the large ungulates such as caribou, and also on other important species such as the barren-ground grizzly and dall sheep. Some fairly long above-ground stretches of pipeline will be along the North Slope, where the route runs through the area of overlap in the ranges of two caribou herds; together totalling some 500 000 animals. Research has indicated that in the course of a year just over 6 per cent of these caribou will need to cross the pipeline. In order to ensure their freedom of movement, crossing ramps, probably of gravel, will be installed. We know from experience in the Prudhoe Bay and Kenai Peninsula oilfields that both caribou and moose will readily use and cross gravel roads.

Certain segments of the route are of particular importance in terms of wildlife, and one such area is the Atigun Canyon through which the Atigun River flows to join the Sagavanirktok River. This canyon, some nine miles in length, is one of the most important areas for dall sheep in the Brooks Range. The sheep population reaches a peak in May and June when lambing takes place; at this time there may be 300 sheep in the canyon. We now know that the lambing grounds are on the alpine meadows lying above and back from the canyon proper, so there will be no disturbance problems involved.

Throughout the Atigun Canyon the pipeline will be buried in the river bed, so it will not form a physical barrier to sheep crossing the canyon from one side to the other. This burial, however, was the source of two further objections—disruption of the movements of anadromous fish (which migrate from salt to fresh water) and thermal pollution. In the majority of the numerous river crossings the pipeline will be buried at right angles to the channel and calculations show thermal effects on the water will be unimportant.

Concern for fish populations in the Atigun and Sagavanirktok drainages resulted in extensive research, particularly into arctic char and grayling. This research has shown that in the case of this drainage system there are two types of arctic char; a freshwater resident population and an exclusively migratory population. The latter are rare or absent in the Atigun River and its tributaries. It also appears that the Sagavanirktok River itself is primarily a route by which fish reach spawning grounds in the tributaries, and does not itself contain any significant spawning areas. At the time of the spring thaw this river carried an extremely heavy load of material in suspension and we now know that natural replacement of gravel is rapid and experiments are being set up to measure this. This gravel extraction for road making should not have serious effects. In any case, whenever possible gravel will be extracted from sources away from active river beds.

At present an average depth of 5 ft of gravel is needed to insulate a road from the underlying permafrost. Substantial progress has been made with research into alternative methods of road insulation. Tests with a polyurethane rigid foam in conjunction with a special sealing compound have proved very successful. It is also interesting that the IBP observations on birds suggest that the presence of gravel roads and artificial impoundments of meltwater serve to diversify the habitat, with a resulting increase in the numbers of various species.